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A New Misconduct Case: Plagiarism Via Peer Review

A recurrent nightmare of researchers, that their manuscripts will be plundered for self-advantage by anonymous referees, has materialized in a malodorous case disclosed last week by the National Institutes of Health.

Based on a 10-month investigation, NIH concluded that Professor C. David Bridges, while on the faculty of the Baylor College of Medicine, misused his access as a manuscript reviewer to commit "an egregious misconduct of science that undermines the entire concept and practice of scientific experimentation and ethical responsibility." NIH declared that Bridges, a grantee since 1976, "laid a 'trail of deception'" when confronted by investigators of charges that he lifted material from a manuscript destined for *The Proceedings of the National Academy of Sciences* (PNAS), and published it in *Science*.

Bridges' $1 million, 5-year NIH grant ran out in June and has not been extended; he's been barred from advisory duties at NIH, and NIH has recommended his debarment from further federal funding, a decision that's up to the Department of Health and Human Services.

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In a reply to NIH, Bridges, who moved to Purdue University in 1987, stated, "I totally reject the outrageous allegation of plagiarism." Bridges declined to discuss the case with SGR, and referred inquiries to Purdue, where a spokesman emphasized that the disputed publication preceded Bridges' appointment to the faculty. The spokesman said Purdue would appoint a committee to investigate the case.

Though the NIH investigation concerned only Bridges, also involved is the editorial judgment of *Science* magazine, which published Bridges' paper despite a letter of concern from the lead author of the plagiarized manuscript. And then, too, the NIH inquiry disclosed questionable behavior by other participants in the peer review system. All in all, this is one of the most embarrassing cases to explode in the face of science in some time.

The case arises from an important research finding on the biochemistry of the visual process, first published in the April 1987 PNAS by a team headed by Robert R. Rando, Professor of Pharmacology at Harvard Medical School. The PNAS paper identified the enzyme capable of catalyzing an essential chemical conversion in vision—"an identification that has eluded all previous attempts by many scientists, including Dr. Bridges," according to the NIH report.

Rando's publication was followed by a suspicious clone in the June 26, 1987, *Science* by a two-member team headed by Bridges, then of Baylor University, where he held professorships in Ophthalmology at the College of Medicine and in the Department of Biochemistry. In October 1987, as controversy flared about the two papers, Bridges moved to Purdue University, where he is currently a Professor in the Department of Biological Sciences.

If plagiarism were all that's involved, the case could be regarded as just one of those events bound to happen in a heavily populated and competitive scientific community. But also involved are several institutions that are supposed to safeguard the processes of science, among them *Science* magazine. It published Bridges' plagiarized work despite ample warning from Rando of Harvard about "very similar

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In Brief

Hubert Curien, French Minister of Research and Technology, canceled a long-planned visit to Washington for the end of June because he couldn't find many senior science-policy officials to talk to. Curien couldn't land an appointment with the Chairman of the Space Council, Vice President Quayle. The post of White House Science Adviser still awaits Senate confirmation. NIH is headed by a lame duck, James Wyngaarden, due to leave August 1, with a replacement not yet named. NSF Director Bloch agreed to a meeting with Curien, which took place in Paris July 3, while Bloch was en route home from a visit to Moscow.

The R&D growth rate this year will fall to a real one percent, lowest since 1975, NSF reports, adding that "The lackluster performance is attributable both to a downturn in R&D funding by industry and to tightening Federal budgetary constraints." (Details are in a brief report, NSF-89-301, available without charge from: NSF, Division of Science Resources Studies, 1800 G St. NW, Washington, DC 20550; tel. 202/634-4634.)

A $200 million start-of-construction appropriation for the Superconducting Super Collider (SSC) easily escaped the budget ax during an Energy Department spending spree June 28 on the House floor. But with many appropriations running above rigid Gramm-Rudman levels, a reckoning is due later this summer, and the SSC will then face a formidable test.

During the debate, Rep. Dennis E. Eckart (D-Ohio) noted that, despite DOE assurances of foreign financial participation, "in six years of advancing this project, we have not had a single written commitment for a single foreign dollar. . ." On July 10, the Washington Post *editorialized against the SSC on the grounds that it would strip scarce funds from other fields of research.*

. . . Adviser on Paper Also Reviewed It for *Science*

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material" present in the paper sent to Bridges for review and published prior to Bridges' *Science* article.

Upon receiving a copy of the Rando paper from PNAS with a request to serve as a referee, Bridges excused himself on the grounds of a heavy travel schedule and personal involvement in a similar line of research, the NIH report states. But, it notes, he also informally recommended against publication, contending that the Rando paper was "messily written" and "lacking in primary data." NIH charges that he then lifted Rando's data and incorporated it into a paper first sent to *Nature*, which rejected it, and then sent to *Science*, where it was eventually published.

The NIH panel concluded that the experimental result reported by Bridges "either was revealed to Bridges in its entirety through some intuitive leap (a rarity in experimental science). . . or was plagiarized from the Rando manuscript available to him in August 1986."

While the Bridges paper was in the mill at *Science*, Rando got wind of it from an abstract Bridges submitted to a meeting they both attended. According to the NIH report, Bridges, after being confronted by Rando, "agreed to make changes in his *Science* article, then in press, that would reflect his having seen the Rando manuscript as a referee." But the *Science* article merely contains a footnote with a reference to Rando's PNAS article and the cryptic statement: "A version of the latter manuscript was shown to the present authors by J.E. Dowling."

And thus arises another issue of propriety in the peer-review process. Dowling is a Harvard professor and a member of the National Academy of Sciences, which publishes PNAS. (At the time, he was also Chairman of the NAS Commission on Life Sciences.) On behalf of PNAS, it was Dowling who asked Bridges to review the Rando paper that was later published in PNAS.

When Rando came across the Bridges abstract that reflected his own paper, he asked Dowling for the names of the reviewers. Dowling, in what NIH describes as "a departure from accepted procedure," told him that Bridges was among the referees. In response to an inquiry, Dowling told SGR that Bridges and Rando are "in a tiny field," and "it was logical I would send" the Rando paper to Bridges for review.

Dowling said that "Rando confronted me directly" concerning whether Bridges had seen the manuscript, "and I acknowledged that he had." Dowling disputed NIH's contention of "a departure from accepted procedure."

Rando and Bridges then conferred and, according to Rando, agreed that the *Science* article would be modified to reflect Rando's priority.

And then there's a professor at the University of Florida, Paul A. Hargrave, described in the official NIH report as having advised Bridges on preparing the manuscript for submission to *Science* (after *Nature* turned it down), and then serving as a reviewer of the paper for *Science*. When SGR telephoned Hargrave to inquire about his involvement in the proceedings, he said he had not seen the NIH report and therefore would not comment.

The NIH investigating panel expressed a low opinion of the paper Bridges published in *Science*, stating that it contains "internal inconsistencies, incomplete data, and misinformation." Asked by SGR why he published the paper, despite notification of prior publication, *Science* Editor Daniel E. Koshland Jr. responded that "if we accept a paper in good faith, and then something similar is first published elsewhere, we'll go ahead and publish it anyway out of consideration for the author." He also said that accusations of plagiarism are too common to warrant automatic attention.

In atonement for having been the vehicle for what NIH has officially deemed a plagiarism, Editor Koshland is publishing a brief "Notification to Readers" in *Science* of July 14. The item quotes the NIH finding that Bridges "did plagiarize" the Rando article, "misused the privileged information," and "failed to acknowledge properly the source of that information in his report in *Science*."

In a statement prepared in advance for press inquiries, Koshland explains his decision to publish Bridges' paper though Rando wrote to him six weeks before publication, stating that Bridges' paper contained "very similar material" to the PNAS publication. Rando added in that letter to Koshland that he and Bridges had "reached a verbal agreement that certain changes should be made in the *Science* article to indicate that our paper had been sent to Prof. Bridges for review in July 1986. The changes we agreed on are enclosed. I believe it is very important that there be no discrepancies between the enclosed changes and those sent to *Science* by Prof. Bridges."

Koshland told SGR that he was aware of Rando's letter prior to publication of the Bridges paper, but published the paper despite the fact that it did not contain the changes deemed essential by Rando. In the prepared statement,

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. . . NIH Says Bridges Altered Dates and Lab Data

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Koshland explains: "Shortly before we published [the Bridges paper], we were made aware of Dr. Rando's charges against Dr. Bridges. We decided to proceed with publication for two reasons: 1) We could not injure Dr. Rando by publishing the paper by Bridges. . . because the PNAS paper had preceded the *Science* paper. 2) To deprive Dr. Bridges without due process of a publication that could well have described an independent research finding would have been unfair."

Koshland's statement added: "We have, however, been prepared since June 1987 [date of the Bridges publication in *Science*] to take whatever action was appropriate upon the conclusion of an official and rigorous investigation. With publication of the 14 July notice to our readers, we have taken that action."

In addition to publishing a plagiarized paper of which it had advance notice, *Science* also declined to cooperate with Baylor's investigation of the case. The Chairman of the Baylor inquiry, Professor Vernon Knight, asked Koshland for details of the Rando-Bridges agreement on how the paper in *Science* would acknowledge Rando's priority. The brushoff response, from the *Science* letters editor, was that "we have an overriding obligation to strictly maintain the confidentiality of discussions and correspondence between our editorial staff and reviewers in the scientific community."

While scientific leaders have been telling Congress that universities should be trusted to police themselves, Baylor's performance was poorly rated by the NIH investigating panel. Baylor's own investigators reported on January 12, 1988, that Bridges "attempted improperly to gain priority for his work" and "altered the dates and some of the text of the true records" to create the impression that he was at work on the research reported by Rando before receiving Rando's paper for review. However, the NIH investigating panel charged that the Baylor inquiry "lacked depth and vigor," and showed no curiosity when Bridges reported that he had destroyed the primary laboratory records for the research he reported in *Science*. The NIH panel conceded, however, that Baylor faced a difficult task since Bridges moved to Purdue just as Baylor's inquiry was starting up.

Wary of Koshland because of his repeated dismissal of the misconduct issue as a creation of overheated journalists and failed scientists, the *Science* news staff was politicking internally last week at the parent American Association for the Advancement of Science for a free hand to cover this embarrassing episode in a professional, independent fashion.

Koshland, however, remains ineducable on the very issue that has smeared his editorial doorstep. As the misconduct issue erodes public and Congressional confidence in science, Koshland, editor of the nation's premier scientific journal, performs as a minister of propaganda rather than as head of a publication that includes an important journalistic component.

On June 28, before the NIH investigation had become public knowledge, Koshland testified at a hearing on scientific misconduct before the House Science, Space, and Technology Committee. Without reference to the Bridges case, of which he alone was probably aware among those present, he stated: "Detecting fraud simply by reading a scientific article is very difficult. . . . In most cases. . . a clever deceiver can falsify data in such a way that a reviewer can be fooled; the fraud is usually detected by some other investigator trying to reproduce the work at a later date." He did not refer to circumstances in which a distinguished author of a prior publication explicitly notifies the editor that a pending paper contains stolen data.

Amid this squalid episode there's one bright spot—a markedly improved performance by NIH in taking hold of a misconduct case, appointing and staffing an investigative body, and producing a documented and persuasive report. The job was done within a year, whereas past cases have lingered on, Kafka-style, for three to five years without resolution. Ironically, the case came to NIH only because Bridges protested the negative findings by Baylor's investigating committee and requested a review by NIH.

NIH responded by appointing a five-member outside panel, chaired by Ralph A. Bradshaw, Chairman of the Department of Biological Chemistry, California College of Medicine, Irvine. The panel first met last October, and reports that a month later, Bridges' attorney sought a deal "in which Dr. Bridges would accept some sanctions and agree not to contest the accusation that he had reviewed the manuscript co-authored by Dr. Rando." The offer was promptly rejected, and the panel turned in its report on May 12.

The parties involved were then allowed to comment on it. The final step was preparation by the NIH staff of a decision memorandum for NIH Director Wyngaarden, who approved the verdict and sentence. Incorporated into the memo were strong words from the five-member investigating panel, which stated that "the *Science* paper was seriously flawed, that the research records were not substantiating, and that no evolution of experimentation existed that would have permitted Dr. Bridges to have conducted the experiments he reported without the aid of the privileged information that became available to him in his capacity as a potential reviewer" of Rando's paper.

The panel added that "it considered this plagiarism to be an extremely serious offense and recommended that NIH take commensurate action."

The case comes to light at a time when Congress is of unsettled mind about the extent and significance of scientific misconduct and what, if anything, to do about it. The record in this matter is not likely to be reassuring, for the newly revealed events reek of the ethical laxity deemed rare by the scientific leaders summoned to explain the ways of research to curious Congressional committees.—DSG

Q&A: Charles Hess, New Head of USDA Research

Washington science-policy circles responded with approval to the appointment of Charles E. Hess as Assistant Secretary of Agriculture for Science and Education, the top research-administration post in the US Department of Agriculture. Hess, sworn in May 22, is considered to be in the progressive ranks of the ag research community, an inbred group often accused of scientific isolationism.

Hess came to the Washington job directly from 14 years as Dean of the College of Agricultural and Environmental Sciences at the University of California, Davis. He's a veteran of the Washington science-advisory circuit, having served from 1982-88 on the National Science Board, policymaking body of the National Science Foundation. He also chaired the National Academy of Sciences panel on a National Strategy for Biotechnology in Agriculture. Hess spoke on June 26 to SGR Editor Greenberg. Following is the text, transcribed and edited by SGR.

SGR. Federal agricultural research has gone without budget growth for several years.

Hess. It's been level at about $1 billion, and that's at a time when we have some interesting challenges—food safety, water quality, responding to global climate change, competitiveness. If we're to develop an agriculture which is less dependent upon pesticides, which is environmentally sound, and also maintain our competitiveness, we need a pretty good investment in research. This is at a time when we've got the relatively new tools of biotechnology to help us.

SGR. The National Academy of Sciences is going to recommend a $500 million increase for agricultural research in a report that's coming out soon.

Hess. Yes. This is the National Initiative for Agriculture, Food and the Environment.

SGR. That would increase the agriculture research budget by about one-third—a big jump in the present mood of budget austerity. Will the Department support the budget recommendation?

Hess. Very much so. Secretary Yeutter has been very positive about the idea, and I would hope that we can convince the President that this would be a very fine Presidential initiative for the '91 budget.

SGR. How would the money be used?

Hess. One of the goals is to increase the number and the size of the competitive grants and their duration. Our competitive grants are the smallest among the major agencies. The NIH average grant is something like $140,000, NSF is about $70,000, and agriculture is around $40,000. If you're going to attract the best scientists, regardless of where they are, I don't think you're going to do it for a grant of $40,000, because they're going to have to do as much in terms of preparing for that as for NSF or NIH. The duration of our grants averages about two and a half years. If we could get five-year grants, that would be better, because there's so much energy that goes into the preparation and evaluation of research proposals that it's probably counterproductive.

Part of the new money will be used for building the research capacity of universities that have not been as competitive. There's a concern that the competitive research program benefits a select number of universities and it's unfair to other universities. So, recognizing that, we'd support something like the EPSCoR [Experimental Program to Stimulate Competitive Research] of the National Science Foundation [which aims to raise the research capabilities of schools that rank low in competition for research grants].

Another use of the money in the Initiative would be the conversion of new knowledge into application.

SGR. That seems to suggest a new or expanded role for the Extension Service.

Hess. What we're thinking of would be projects that would be joint Research-Extension projects. I would like to see a closer working relationship between Extension and Research. There is a lot of interest here in terms of new product development and developing non-food, non-feed uses of agricultural products—biodegradable plastics from corn starch, for example. There's a high interest in addressing problems of the economic viability of rural areas and in finding new crops and uses of products which are currently in the surplus category, and to remove the dependency on subsidies.

SGR. The last Administration repeatedly tried to eliminate the Extension Service. Has this Administration declared its policy?

Hess. My sense is that with new leadership in Extension, with [Administrator] Myron Johnsrud [appointed during the Reagan Administration], they have worked on a revitalization of the Extension's role. One of the challenges for the United States is in transferring basic research into products, new ideas into uses. Well, the role of Extension is to take new knowledge and get it down to the users so that they can capitalize on new technology. Extension also serves as a very important feedback mechanism by which new problems in the real world are brought back to the researcher at the bench. I see that as a very important component of our operations.

SGR. There's a standing complaint that biotechnology has not penetrated agricultural research sufficiently.

Hess. I've been conducting a survey of the investment in biotechnology in the agricultural experiment stations across the United States. I started with '82 and I'm now working on the data for 1988. There really has been a substantial increase in the numbers of scientists who are working in biotechnology. The number of projects in biotechnology and the state investments in biotechnology have really increased substantially. That increase has been done largely as reallocations, because the overall number of scientists has remained constant or actually decreased as you look across

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. . . Competitive Grants Favored for New Funding

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the nation. That means that positions have been redirected into the biotech area. I think they have been quite responsive.

Now, the thing that also has to be remembered is that part of the challenge of realizing the full potential of biotechnology lies in research in a whole lot of other areas. There's a need for more basic information in plant physiology, biochemistry, genome structure, and so forth. You don't want everyone in the university to jump onto the molecular biology bandwagon, because you need people doing some of the other basic work.

SGR. There's always tension between the formula programs and the grant programs. Do you see a shift in one direction or another?

Hess. The formula programs remain in a fairly steady state. I think the potential growth would be in the competitive-grants area. But I don't want the growth in competitive grants to be at the expense of the formula funding. The formula funding provides a stable base of funding to do some of the research that may not be fashionable. With formula funding, you can do the high-risk research and the research that's necessary to help make agriculture productive in many ecosystems and geographical areas that we work in.

SGR. Some critics say that the formula research is frequently sterile and that it's not subjected to serious scrutiny.

Hess. That's all in the eyes of the beholder. I'll give you an example. We have had at Davis a person who's worked in strawberry breeding for 40 years. You could say, you've funded that thing for 40 years. Can you really justify it? Well, over the 40 years, he raised the productivity in terms of yield of strawberries from five tons per acre to 40 tons. He's improved the quality of the strawberry. He's changed the nature of the strawberry plant from being what's called a plant regulated by day length, so that it would flower and produce in the spring and again in the fall. And through genetic manipulation, through plant breeding, he made what's called a day-neutral plant. It flowers the whole growing season, and produces strawberries the whole growing season. Those returns transformed the strawberry industry in California initially, but it's all over the United States and in Europe now. But the increases were incremental. They weren't breakthroughs where you went from five- to ten- to twenty-ton yields. That's the type of research that needs a sustained support.

The other would be in the higher-risk areas. In a competitive grants program there's a bit of a problem because you're doing a peer review, and you're asking the reviewer to say what do you think is good. There are fashions in science. If someone comes in with an idea off the wall, particularly at a time when funding is tight and you're funding only 20 percent of the proposals, the chances are that you're not going to take a risk on something that seems to be far out when you have very excellent proposals that are not being funded. So you need to have some resources that aren't dependent on that, to support people to see if their ideas are really worthwhile.

In the National Science Foundation, some of the assistant directors would set aside a little bit of money to take care of that. The formula funding provides an Experiment Station director with that opportunity. The strawberry breeding program might look like sterile research, but it was producing some very good results. The Experiment Stations are asked now to be sure formula projects have peer review within the university to make certain that they're good quality research.

SGR. But the formula funds far outweigh the competitive funds.

Hess. That's why we need to have an initiative.

SGR. The $500 million would go predominantly into competitive grants?

Hess. That's correct.

SGR. Have you had Congressional soundings on this?

Hess. We've had informal discussions with some of the Senators and Congressmen. The response so far has been, well, that's a bold initiative, I would support that, that sounds good. What we're waiting for is for the Academy report to come out so we could then sit down and say, okay, here's a proposal.

SGR. Some of your showcase research centers, Beltsville and others, are literally falling apart. What are you going to do about that?

Hess. There have been some facilities studies.

SGR. There's no end of studies.

Hess. It may be that we're getting to the point where it's time to stop studying and try to invest.

SGR. If you seek $500 million additional for research, does that mean that there will be an accompanying sum for facilities?

Hess. There's a possibility that some of those funds could be used for renovation and so forth. I'd have a little bit of concern about taking a research initiative and making it into a facilities initiative. I think we may have to follow with a facilities plan. In terms of the federal facilities, the need may be greatest. In terms of university facilities, we may look towards the states handling that aspect. It's a real problem. Frank Press [President of the National Academy of Sciences] has been talking about priorities—there are lots of very good, very essential things to do and you have to decide which ones to do.

SGR. There was talk a few years ago about bringing into agricultural research some leading universities that have not been involved with it.

Hess. I think the competitive grants program does do that. We've attracted some very good work at Harvard and MIT. We have nutrition centers associated with Tufts and

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. . . Pork-Barrel Funding a Big Burden on Ag R&D

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Baylor. So there is growth in that area. I think that we want to draw upon the total spectrum of academic researchers. There is a special role that people in the land grant universities can play because they have the continuum from the fundamental to the applied. They often have an understanding of what traits are necessary if they're trying to develop a plant that has disease resistance. So, there is a special role that I see the land grant and state universities playing, particularly taking the fundamental information and carrying it to the application. With the land grant colleges, the linkage with Extension provides a reinforcement and strength that would not be present at a private university. But each has valuable contributions to make.

SGR. Do you have a reorganization plan tucked away somewhere?

Hess. I don't come with a reorganization in mind. There has been some interest, both within and without the Department, to move the competitive grants program to report directly to the Assistant Secretary for Science and Education [rather than, as at present, to the Administrator of the Cooperative State Research Service]. There's an argument that says that if you're successful in the Initiative and there's a large increase in the competitive grants programs, perhaps there should be a change.

That's a fair question, but I don't come with a map. I'm coming with a goal to see if we can convince the Administration and Congress to make a greater investment in research. I would prefer that the increase in research be in the Department rather than in a separately created agency, as some people have suggested—an agency outside of the Department to handle that. There was a suggestion of perhaps an agricultural NSF. It makes sense to me to have it in the Department because of the benefit of the continuum from basic research to the application and having a delivery system to facilitate that.

SGR. Your budget is one of the leading targets for pork-barrel appropriations in Congress.

Hess. It's a very serious problem. The situation has gotten progressively worse, and now people are asking university presidents and deans how come you're not out there getting it? Because look at university X and what they've done. There's tremendous pressure. One approach may be to have a facilities program, maybe with funds from several agencies.

If you don't have a source, you start getting desperate and relying on techniques that you might not otherwise use. If you had a decent program and then said to the community, here's a program, in order to have it, you have to agree that you're only going to go through that route and not through the pork barrel. I would hope that there could be a pact made then between Congress and the federal agencies that this is the way we're going to operate. But right now, the pork barrel appropriations are a major burden for us.

$300,000 Income Listed by Bush's Science Adviser

The requisite federal Financial Disclosure Report filed by D. Allan Bromley, President Bush's nominee for White House Science Adviser, confirms that big-league academic physics can be more than intellectually rewarding.

Bromley, Director of Yale's A.W. Wright Nuclear Structure Laboratory, reported an annual salary from Yale of $133,612. In addition, he reported income from three corporate directorships: $42,744 from UNC, Inc., Annapolis, Md.; $23,200 from United Illuminating Co, New Haven, and $38,051 from Northeast Bancorp, Inc., Stamford and New Haven. In addition $169,234 was listed as scheduled to be paid last month as five-year deferred income on a directorship at the Union Trust Co., New Haven. Bromley also reported $36,204 in honoraria, royalties, retainers, a pension ($3081 from Atomic Energy of Canada), and cash from insurance policies. The combined incomes total over $300,000.

Bromley's financial disclosure form, required of all Presidential appointees, also reported a variety of stock and real estate holdings. Values, given in ranges, rather than in exact amounts, include two entries in the $100,000 to $250,000 range, one in the $50,000 to $100,000, plus three between $5000 to $15,000 and three in the $15,000 to $50,000 range.

The post for which he has been nominated, Director of the Office of Science and Technology Policy (OSTP), currently pays $89,500. The President's recent pay-raise proposal would raise the salary to $111,000, but the politics of federal pay remain unpredictable.

Bromley's selection was announced by the White House April 20 but, because of a backlog of security checks, the formal nomination did not reach the Senate until June 6. But there's a backlog of one thing or another there, too, and as of July 10, the Committee on Science, Space, and Transportation had not scheduled a confirmation hearing.

When the White House named Bromley, it said that he would also serve as Assistant to the President, as have some of his predecessors. Somehow or other that got transmogrified into press reports that he would hold Cabinet rank—first ever for a Presidential Science Adviser. The dwindled staff at OSTP has wearily tried to set the record straight, but has all but given up in the face of congratulatory comments about George Bush's good sense.

Bromley has been spending a few days a week getting briefed on OSTP affairs. Because of a recent illness in his family, he is reported to be not all that dismayed about the slow pace to Washington.

. . . In Print: House Science Hearings, Futurists

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The Adequacy, Direction and Priorities for the American Science and Technology Effort (GPO Stock No. 552-070-061-82-7, 272 pp., $9), transcript and supplementary materials from hearing last February 28-March 1 by the Subcommittee on Science, Research, and Technology of the House Science, Space, and Technology Committee. Witnesses included senior sci-tech researchers and administrators from academe, industry, think tanks, etc.

Order from: Superintendent of Documents, USGPO, Congressional Sales Office, Washington, DC 20402-9315; tel. 202/275-3030. Note: GPO says the print order was small and the supply is low.

What Futurists Believe, by Joseph F. Coates and Jennifer Jarratt (published by World Future Society and Lomond Publications, 340 pp., $29.50), summaries and analyses of the writings of 17 "futurists," including Daniel Bell, Kenneth Boulding, Arthur C. Clarke, Peter Drucker, and Richard Lamm.

Order from: Lomond Publications, PO Box 88, Mt. Airy, Md. 21771; tel. 301/875-5475 or 1-800-443-6299.

Challenges (monthly, 12 pp., no charge), newsletter of the Council on Competitiveness, Washington-based alliance of academe and high-tech industry (with a mild flavoring of organized labor), provides brief, uncritical accounts of many schemes afoot to rejuvenate American industry.

Order from: Council on Competitiveness, Attn. Ms. Appel, 1331 Pennsylvania Ave. NW, Suite 900, North Lobby, Washington, DC 20004; tel. 202/662-8760.

Job Changes, Appointments

Bernd-Uwe Jahn, Counselor for Scientific and Technological Affairs at the West German Embassy in Washington since 1985, has been assigned to the policy office of the newly established Agency for Aerospace within the Federal Ministry for Research and Technology, Bonn. His replacement is ***Irene Reuder***, formerly in the Ministry press office.

Daniel De Simone has resigned as Executive Director of the American Association of Engineering Societies, and will be succeeded by ***Mitchell H. Bradley***, Managing Director of Public Affairs for the American Society of Mechanical Engineers. De Simone, a veteran of Washington science-policy service, held the post since 1984, and plans to return to private practice and write a book.

J. Michael Davis has been nominated to be Assistant Secretary for Conservation and Renewable Energy in the Department of Energy. Davis served with DOE from 1977-80 and is currently President of GlowCore Colorado, Inc.

David Dickson has resigned as European Correspondent of *Science*, a post he held since 1982, and will become News Editor of the British weekly ***New Scientist***..

National Patterns of R&D Resources: 1989 (NSF 89-308, 72 pp., no charge), provides the big picture on US R&D spending and activities, with some international comparisons. Included are state rankings in R&D. California is No. 1 by far, with funds from all sources totaling $22 billion; next comes New York, $8.3 billion; New Jersey, $6.7 billion; Michigan, $6.3 billion; Massachusetts, $6 billion, and Maryland, $4.9 billion.

Order from: NSF, Division of Science Resources Studies, 1800 G St. NW, Washington, DC 20550; tel. 202/634-4634.

Final Site Selection Process for DOE's Super Collider (GAO/RCED-89-129BR; 53 pp., no charge), by the General Accounting Office, reports finding "no reason to question the decision to site the super collider in Texas," though on this or that item, various other sites were deemed equal or superior.

Order from: USGAO, PO Box 6015, Gaithersburg, Md. 20877; tel. 202/275-6241.

Who's Who in Technology (Sixth Edition, two vols., 2742 pp., $380), 38,000 biographical entries on North Americans in 46 scientific and technological fields. New features include geographic, employer, and technical discipline indexes.

Order from: Gale Research, Book Tower, Detroit, Michigan 48226; tel. 1-800-223-GALE; in Michigan, 313/961-2242.Fax No. 313/961-6083.

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In Print: NSF Update on International R&D Data

The publications listed are obtainable as indicated—not from SGR.

International Science and Technology Data Update: 1988 (NSF 89-307, 95 pp., no charge), latest in NSF's annual series of international statistical comparisons of R&D-related activities, with the focus mainly on the US, France, West Germany, Japan, and Britain. Included are budgets and patterns of spending, education, migrations of technical specialists, shares of scientific and engineering literature, patents, and high-tech trade balances. The publication, which includes more detail with each annual edition, also provides selected information on 50 other nations.

Order from: NSF, Division of Science Resources Studies, 1800 G St. NW, Washington, DC 20550; tel. 202/634-4634. NSF's international S&T data are also available via modem on 202/634-1764. Tables in *International Science and Technology Update* may be obtained on diskette (no charge) in Lotus 1.0 format by mailing two blanks to NSF Diskette Service, RDS Systems, 6110 Executive Blvd., Suite 605, Rockville, Md. 20852

Federal Funds for Research and Development: Fiscal Years 1987, 1988, and 1989 (NSF 89-304, 108 pp., no charge), also an NSF annual, this one consists of nearly 100 pages of tables detailing federal R&D spending by agency source, purpose, type of organizational recipient, geographic patterns of awards, etc. Many of the tables cover a decade or more.

Order from: NSF, Division of Science Resources Studies, 1800 G St. NW, Washington, DC 20550; tel. 202/634-4634.

Strategic Defenses: Alternative Missions and Their Costs (81 pp., no charge), by the Congressional Budget Office, describes four alternative versions of Strategic Defense Initiative spending for fiscal 1990-94: a minimalist "hedge" against Soviet advances (five-year cost: $11.3-$14.5 billion); deployment of accidental-launch protection system ($17 billion); a silo-protection system ($18.4 billion), and the Bush Administration plan "to develop and begin deployment of a system. . . to destroy a significant portion of an initial Soviet attack" ($31 billion). Since 1984, SDI has spent $17 billion, the CBO reports.

Order from: Congressional Budget Office, Publications, House Annex II, R. 413, 2d and D Sts. NW, Washington, DC 20515; tel. 202/226-2809.

Space Operations: Listing of NASA Scientific Missions, 1980-2000 (GAO IMTEC-89-46FS, 22 pp., no charge), this report responds to a mysterious hole in space record keeping: "NASA officials told us that a combined, current list of active and planned missions was not available," reports the General Accounting Office, Congress's own investigatory service. Relying on a variety of records, GAO assembled a list covering scores of planetary, lunar, earth sciences, space physics, and astrophysics missions. Not included are missions in biology and life sciences, manufacturing sciences, and communication technology.

Order from: USGAO, PO Box 6015, Gaithersburg, Md. 20877; tel. 202/275-6241.

Biological Effects of Power Frequency Electric and Magnetic Fields—Background Paper (GPO Stock No. 052-003-01152-2, 103 pp., $4.75), by the Congressional Office of Technology Assessment, says "emerging evidence" supports long-disputed claims that power-frequency fields pose human health risks, but nothing indicates "significant risk," OTA adds. The report was requested by the Subcommittee on Water and Power Resources of the House Committee on Interior and Insular Affairs. Previously published OTA studies in related areas:

Electric Power Wheeling & Dealing: Technological Considerations for Increasing Competition (GPO Stock No. 052-003-01153-1, 276 pp., $12);

New Electric Power Technologies: Problems and Prospects for the 1990s (GPO Stock No. 052-003-01005-4, 340 pp., $12).

Order from: USGPO, Superintendent of Documents, Washington, DC 20401-9325; tel. 202/783-3238

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